


To: <p style="text-align: center;">SUPERSEDED BY EI 95-047 EFFECTIVE 10/31/1995</p>		<p style="text-align: center;">ENGINEERING INSTRUCTION</p> <p style="text-align: center;"><i>New York State Department of Transportation</i></p>	<p style="text-align: center;">95-034</p> <hr/> Supersedes: 94-037
Title: CONSTRUCTION SIGNS - MANDATED USE OF FLUORESCENT ORANGE REFLECTIVE SHEETING			
Distribution: <input checked="" type="checkbox"/> Main Office(30) <input checked="" type="checkbox"/> Local Gov.(31) <input checked="" type="checkbox"/> Regions(32) <input checked="" type="checkbox"/> Contractors/AGC(39) <input checked="" type="checkbox"/> Consultants(34) <input type="checkbox"/> _____ ()	Approved: _____ <i>P. J. Clark</i> <u>7/27/95</u> P. J. Clark, Director, Design Division Date		

EI 94-037 issued special specification Items 15619.02 and 15619.02 M (Metric) - Construction Signs (Fluorescent Orange Reflective Sheeting). These special specifications required the use of fluorescent orange reflective sheeting for the standard orange colored, rigid panel construction signs. Fluorescent orange sign sheeting is reported to make construction signs more conspicuous, especially under rainy and foggy conditions.

Attached are revised specification Items 15619.0201 and 15619.0201 M (Metric) - Construction Signs which supersede special specification Items 15619.02 and 15619.02 M (Metric), and the Standard Specification Pay Item 619.02 Construction Signs. These new specification items should not increase costs and should be used in the design of new projects in the following manner.

- **Interstate, Parkway, and Expressway Projects.** These type of highway projects, and their sideroads, crossroads, overpasses, and underpasses, are to use the new attached specification items beginning with the letting of November 30, 1995.
- **All Other Projects.** For all other types of projects, the new attached specification items are to be used starting with the first letting in calendar year 1996.

The new Items 15619.0201 and 15619.0201 M (Metric) - Construction Signs will be main office inserted specifications for the interstate, parkway, and expressway projects. These specifications may also be used on other projects let in the remainder of this year, if desired by the Region. Starting with lettings in calendar year 1996, it is expected that the Standard Specifications for construction signs will be modified for use in all projects. At that time, the special specification items will no longer be necessary.

Construction inspection personnel should note that fluorescent orange reflective sheeting is only required for construction signs with rigid panel substrates. The currently approved materials are not designed for flexible, "roll-up" sign panel application.

In conjunction with the new Items 15619.0201 and 15619.0201 M (Metric), the Standard Specification Section 730-05 Reflective Sheeting has been updated. Attached are two revised versions of Sections 730-05 (English and Metric) which update the specifications for Classes A thru C sheeting, and add new requirements for Class D (Materials Designation 730-05.04) fluorescent orange reflective sheeting.

EI 95-034
Page 2 of 2

Fluorescent orange reflective sheeting materials which meet these specification requirements appear on the Department's Approved List of reflective sheetings.

The attached Sections 730-05 Reflective Sheeting are an addenda to the Standard Specifications, and will be main office inserted into contract proposals effective with the use of the new Items 15619.0201 and 15619.0201 M.

If there are any questions regarding this E.I. or the attached specifications, contact Larry Brown of the Design Quality Assurance Bureau (518) 457-4093, or Harry Sloan of the Materials Bureau at (518) 457-4285.

ITEM 15619.0201 - CONSTRUCTION SIGNS

DESCRIPTION

This work shall consist of furnishing, installing, maintaining, and moving construction signs, as shown in the contract documents, or as directed by the Engineer, and in accordance with the Manual of Uniform Traffic Control Devices (MUTCD).

MATERIALS

Rigid sign panels may be aluminum, fiberglass, galvanized steel, or plywood, except that sign panels placed on Type III Breakaway Barricades shall be aluminum.

On rigid panels, all colors of sign faces, except orange, shall be reflectorized and meet the requirements of Section 730-05 Reflective Sheeting, Materials Designation 730-05.02 (Class B). When orange signs on rigid panels are specified they shall be fabricated using reflectorized fluorescent orange colored sheeting meeting Materials Designation 730-05.04 (Class D).

Flexible sign panels shall be a solid, orange colored, durable elastomeric material. Flexible sign panels fabricated from mesh will not be allowed.

Flexible signs shall be orange in color and a reasonable visual match to Munsell Book Notation 2.5 YR 5.5/14. The orange color flexible panels shall be approved by the Engineer prior to use. Flexible sign panels need not be reflectorized.

Black sign characters shall be non-reflective, and shall conform to the requirements of §730-13 Reflectorized Sheeting Sign Characters (Type V).

White sign characters shall meet the requirements of either §730-12 Reflectorized Sheeting Sign Characters (Type IV) or §730-13 Reflectorized Sheeting Sign Characters (Type V).

Covers used to inactivate unneeded signs shall match the size and shape of the sign and shall cover the entire sign face. The cover material shall be a heavy duty, porous, opaque cloth, dark green, brown, black, or white in color. Materials such as plastic, polyethylene, burlap, and filter fabric, will not be allowed for use as sign covers. The sign cover shall be attached to the sign in a secure manner using straps or other means approved by the Engineer. The finished sign cover shall be neat in appearance with all fasteners secured on the backside of the sign face.

CONSTRUCTION DETAILS

The applicable requirements of Section 619 Maintenance and Protection of Traffic shall apply.

The contractor shall furnish and erect appropriate construction signs to adequately and safely inform and direct the motorist and to satisfy legal requirements. All signs shall indicate actual conditions, and shall be removed and/or relocated, or changed immediately as required in the contract documents and as directed by the Engineer.

All signs shall be the property of the contractor and shall be maintained in good condition for the duration of the contract. All signs shall be removed from the work site when the contract is accepted.

Sign sizes and details shall conform to the standard sheets, MUTCD, and the contract documents. The number of signs indicated on the standard sheets, in the MUTCD, and in the contract documents are a minimum number and the contractor shall have an adequate quantity of these signs available for immediate use, as required. The Engineer may order that additional signs be used.

All wood supports, and backs of plywood sign panels shall be painted with two coats of white paint.

All signs shall be kept clean, mounted at the required height on adequate supports, and placed in the proper position and alignment so as to give maximum visibility. In general, sign orientation shall conform to the MUTCD, Section 201.5, subdivision (g), Orientation except that the vertical and horizontal mounting angle tolerance shall be plus or minus 5 degrees, as appropriate.

Signs that are erected and removed or relocated on a daily basis, or that must be frequently relocated to adjust to the location of construction operations, may be mounted on portable sign supports. Signs that are to remain at a fixed location may be supported on posts mounted in the ground. The type of sign supports used shall be selected by the contractor, subject to the approval of the Engineer. If rigid diagonal bracing is used, the high end of the bracing shall face away from approaching traffic. All supports, except those located beyond the deflection distances of guiderail or temporary barrier, or otherwise protected against impact by errant vehicles, shall meet the following safety requirements for portable and fixed supports.

1. **PORTABLE SUPPORTS.** Ballast used to stabilize supports shall be bagged sand or other suitable material approved by the Engineer, and shall be located at ground level. Portable supports shall comply with one of the following:

- a. Manufactured portable supports designed for the display of signs in temporary traffic areas.
 - b. Wood supports fabricated by the Contractor, with a maximum member size of 2 inches by 6 inches.
 - c. Metal supports fabricated by the Contractor, using square perforated or unperforated steel tube, maximum size 2 inches, conforming to ASTM A446 Grade A.
2. **FIXED SUPPORTS.** If stakes are used to attach the lower end of diagonal braces to the ground, they shall not protrude more than 4 inches above the ground surface. Fixed supports shall comply with one of the following:
- a. Type A Sign Supports meeting the requirements of §730-24 and the applicable Materials Details may be used for sign sizes appropriate for those supports.
 - b. Sign posts and footings meeting the requirements of §730-20 and the applicable Standard Sheets may be used for sign sizes appropriate for those supports.
 - c. Wood posts, excluding any synthetic or composite wood product, may be used as follows:
 1. Wood posts up to 4 inches by 4 inches.
 2. Wood posts up to 6 inches by 8 inches having 2 holes of 3 inches diameter, drilled in the direction perpendicular to the flow of traffic and located 4 inches and 18 inches above ground level. These holes shall be filled with flexible caulking.
 3. Wood posts larger than 6 inches by 8 inches shall not be used.
 4. No more than two posts of acceptable sizes as listed above shall be located within a single 7 foot width.
 - d. Any other support that the Contractor may select, upon submission of documentation to the Engineer demonstrating that the post selected meets the current AASHTO and NCHRP criteria for impact performance of Highway Sign Supports.

Supports for construction signs shielded by barrier or guiderail, and located beyond the deflection distance described below, do not have to conform to the above safety requirements.

GUIDERAIL & CONCRETE BARRIER DEFLECTION DISTANCES

Guide Rail Type	Post Spacing	Deflection Distances
Cable	16 feet	11 feet
	12 feet	9 feet 6 inches
	8 feet	8 feet
	4 feet	7 feet
Corrugated Beam (Weak Post)	12 feet 6 inches	8 feet
	6 feet 3 inches	6 feet
	4 feet 2 inches	5 feet
Corrugated Beam (Heavy Post)	6 feet 3 inches	4 feet
	3 feet 1½ inches	2 feet
Box Beam	6 feet	5 feet
	3 feet	4 feet
Concrete Barrier	NOT APPLICABLE	0 feet

Flexible signs will only be allowed for short-term, daytime use, for portable type signs that are deployed for use on a daily basis. They may not be used overnight, or for signs mounted on supports installed in the ground, or on portable supports that are left in place continuously for more than one work day. All flexible sign panels shall be mounted on supports with adequate bracing, so as to minimize flutter and to support the intended shape of the sign.

Intermixing reflective fluorescent orange colored signs with non-fluorescent orange colored flexible signs within the same series of signs shall not be allowed.

All construction signs shall be mounted in accordance with the MUTCD. Signs on rigid panels shall be mounted at a minimum height of five feet. Flexible sign panels shall be mounted at a minimum height of five feet, or optionally as low as one foot when the following conditions are met:

1. On two lane, two-way roadways and four lane divided highways, when signs are placed on the left and the right sides of the roadway.
2. Where there will be no parked vehicles to obstruct the view.
3. When at least one advance work zone warning sign, mounted at a height of five feet is located upstream of any flexible signs to alert motorists that they are entering a construction zone.
4. When the Engineer determines that the lower mounting height does not adversely affect the motorists' visibility of the sign.

If signs are temporarily covered, the cover shall be attached in a manner that completely covers the face of the sign. No adhesive shall be applied to the face of the sign, and the method of attaching the cover shall not damage the sign face. Sign covers shall be secured firmly to prevent dislodging and shall be maintained in good condition to present a neat appearance and minimize distraction to motorists traveling through the work zone. Sign covers shall contain no wording or images. Damaged covers which are determined by the Engineer to be no longer effective shall be replaced.

On limited access highways, when the normal legal speed limit is 50 MPH and higher, the contractor shall have available at the project site, sufficient warning signs as described below, to inform oncoming traffic of a stopped, or very slow traffic condition. These signs shall be placed, moved, covered, maintained and removed in a manner directed by the Engineer.

The sign shall measure 48" by 48", and letters shall be 7" Series D, similar to a W8-10, except it shall read "BE PREPARED TO STOP." The background color shall be fluorescent orange (Materials Designation 730-05.04, Class D). Each sign shall be mounted on a suitable portable support, and each shall be equipped with a pair of warning flags conforming to the requirements of the MUTCD, Section 294.2. Both sides of the approach shall be signed unless the median is too narrow, or if there are fewer than three lanes in the approach.

The sign shall be posted approximately 1500 feet upstream of the end of the queue, and when the end of the queue moves, the sign shall also be moved to maintain that spacing. If the resulting location places the sign upstream of the first warning sign for the project, the contractor shall also furnish and place an appropriate general work zone sign. The work zone sign shall be placed approximately 1000 feet in advance of the "BE PREPARED TO STOP" sign.

Whenever a reduced regulatory speed limit for a highway work zone has been legally established by any means, the R-2 speed limit signs and, if used, the R2-10 speed zone

ahead signs for reduced speed shall be supplemented by a work zone warning panel as described below.

The panels shall be the same width as the speed limit sign they are supplementing. They shall be 6 inches high with 3 inch Series B lettering when used with size B speed limit signs; 8 inches high with 4 inch Series B lettering when used with size C speed limit signs; 12 inches high with 6 inch Series B lettering when used with size D speed limit signs and 16 inches high with 8 inch Series B lettering when used with size E speed limit signs. The panel shall read 'WORK ZONE' with black legend and fluorescent orange background (Materials Designation 730-05.04, Class D).

These panels shall be placed on the same posts and immediately above the speed limit signs.

METHOD OF MEASUREMENT. Payment shall be made at the lump sum price bid.

BASIS OF PAYMENT. The lump sum price bid shall include the cost of labor, equipment and material, necessary to erect, remove, relocate, protect, maintain, store or replace any construction signs required to properly sign the contract. The lump sum price bid shall also include the cost of repairing or replacing reflectorized signs, when the Engineer determines that the reflective sheeting material no longer meets the specifications.

No payment will be made under Section 619 Basic Maintenance and Protection of Traffic for each calendar day during which there are substantial deficiencies in compliance with the requirements of this specification, as determined by the Engineer. The amount of each calendar day non-payment will be determined by dividing the lump sum bid by the number of calendar days between the date the contractor commences work and the date of contract completion, as designated in the contract proposal, without regard to any extension of time.

In addition, liquidated damages will be assessed at the rate shown in Table 108-1 of Section 108-03, for each calendar day or part thereof that a cited deficiency, which results in non-payment, is not corrected, or is permitted to recur.

Partial payments will be made. Fifty (50) percent of the lump sum price will be paid when ten (10) percent of the contract work has been completed. The remaining fifty (50) percent will be paid proportionally in accordance with the total contract work completed, beginning with the estimate following the initial payment on this item.

ITEM 15619.0201 M - CONSTRUCTION SIGNS

DESCRIPTION

This work shall consist of furnishing, installing, maintaining, and moving construction signs, as shown in the contract documents, or as directed by the Engineer, and in accordance with the Manual of Uniform Traffic Control Devices (MUTCD).

MATERIALS

Rigid sign panels may be aluminum, fiberglass, galvanized steel, or plywood, except that sign panels placed on Type III Breakaway Barricades shall be aluminum.

On rigid panels, all colors of sign faces, except orange, shall be reflectorized and meet the requirements of Section 730-05 Reflective Sheeting, Materials Designation 730-05.02 (Class B). When orange signs on rigid panels are specified they shall be fabricated using reflectorized fluorescent orange colored sheeting meeting Materials Designation 730-05.04 (Class D).

Flexible sign panels shall be a solid, orange colored, durable elastomeric material. Flexible sign panels fabricated from mesh will not be allowed.

Flexible signs shall be orange in color and a reasonable visual match to Munsell Book Notation 2.5 YR 5.5/14. The orange color flexible panels shall be approved by the Engineer prior to use. Flexible sign panels need not be reflectorized.

Black sign characters shall be non-reflective, and shall conform to the requirements of §730-13 Reflectorized Sheeting Sign Characters (Type V).

White sign characters shall meet the requirements of either §730-12 Reflectorized Sheeting Sign Characters (Type IV) or §730-13 Reflectorized Sheeting Sign Characters (Type V).

Covers used to inactivate unneeded signs shall match the size and shape of the sign and shall cover the entire sign face. The cover material shall be a heavy duty, porous, opaque cloth, dark green, brown, black or white in color. Materials such as plastic, polyethylene, burlap, and filter fabric, will not be allowed for use as sign covers. The sign cover shall be attached to the sign in a secure manner using straps or other means approved by the Engineer. The finished sign cover shall be neat in appearance with all fasteners secured on the backside of the sign face.

CONSTRUCTION DETAILS

The applicable requirements of Section 619 Maintenance and Protection of Traffic shall apply.

The contractor shall furnish and erect appropriate construction signs to adequately and safely inform and direct the motorist and to satisfy legal requirements. All signs shall indicate actual conditions, and shall be removed and/or relocated, or changed immediately as required in the contract documents and as directed by the Engineer.

All signs shall be the property of the contractor and shall be maintained in good condition for the duration of the contract. All signs shall be removed from the work site when the contract is accepted.

Sign sizes and details shall conform to the standard sheets, MUTCD, and the contract documents. The number of signs indicated on the standard sheets, in the MUTCD, and in the contract documents are a minimum number and the contractor shall have an adequate quantity of these signs available for immediate use, as required. The Engineer may order that additional signs be used.

All wood supports, and backs of plywood sign panels shall be painted with two coats of white paint.

All signs shall be kept clean, mounted at the required height on adequate supports, and placed in the proper position and alignment so as to give maximum visibility. In general, sign orientation shall conform to the MUTCD, Section 201.5, subdivision (g), Orientation except that the vertical and horizontal mounting angle tolerance shall be plus or minus 5 degrees, as appropriate.

Signs that are erected and removed or relocated on a daily basis, or that must be frequently relocated to adjust to the location of construction operations, may be mounted on portable sign supports. Signs that are to remain at a fixed location may be supported on posts mounted in the ground. The type of sign supports used shall be selected by the contractor, subject to the approval of the Engineer. If rigid diagonal bracing is used, the high end of the bracing shall face away from approaching traffic. All supports, except those located beyond the deflection distances of guiderail or temporary barrier, or otherwise protected against impact by errant vehicles, shall meet the following safety requirements for portable and fixed supports.

1. **PORTABLE SUPPORTS.** Ballast used to stabilize supports shall be bagged sand or other suitable material approved by the Engineer, and shall be located at ground level. Portable supports shall comply with one of the following:

- a. Manufactured portable supports designed for the display of signs in temporary traffic areas.
 - b. Wood supports fabricated by the Contractor, with a maximum member size of 50 mm by 150 mm.
 - c. Metal supports fabricated by the Contractor, using square perforated or unperforated steel tube, maximum size 50 mm, conforming to ASTM A446 Grade A.
2. **FIXED SUPPORTS.** If stakes are used to attach the lower end of diagonal braces to the ground, they shall not protrude more than 100 mm above the ground surface. Fixed supports shall comply with one of the following:
- a. Type A Sign Supports meeting the requirements of §730-24 and the applicable Materials Details may be used for sign sizes appropriate for those supports.
 - b. Sign posts and footings meeting the requirements of §730-20 and the applicable Standard Sheets may be used for sign sizes appropriate for those supports.
 - c. Wood posts, excluding any synthetic or composite wood product, may be used as follows:
 1. Wood posts up to 100 mm by 100 mm.
 2. Wood posts up to 150 mm by 200 mm having 2, 80 mm diameter holes drilled in the direction perpendicular to the flow of traffic and located 100 mm and 450 mm above ground level. These holes shall be filled with flexible caulking.
 3. Wood posts larger than 150 mm by 200 mm shall not be used.
 4. No more than two posts of acceptable sizes as listed above shall be located within a single 2.1 m width.
 - d. Any other support that the Contractor may select, upon submission of documentation to the Engineer demonstrating that the post selected meets the current AASHTO and NCHRP criteria for impact performance of Highway Sign Supports.

Supports for construction signs shielded by barrier or guiderail, and located beyond the deflection distance described below, do not have to conform to the above safety requirements.

GUIDERAIL & CONCRETE BARRIER DEFLECTION DISTANCES

Guide Rail Type	Post Spacing	Deflection Distances
Cable	4880 mm	3350 mm
	3660 mm	2900 mm
	2440 mm	2440 mm
	1220 mm	2130 mm
Corrugated Beam (Weak Post)	3810 mm	2440 mm
	1900 mm	1830 mm
	1270 mm	1520 mm
Corrugated Beam (Heavy Post)	1900 mm	1220 mm
	950 mm	610 mm
Box Beam	1830 mm	1520 mm
	910 mm	1220 mm
Concrete Barrier	NOT APPLICABLE	0 mm

Flexible signs will only be allowed for short-term, daytime use, for portable type signs that are deployed for use on a daily basis. They may not be used overnight, or for signs mounted on supports installed in the ground, or on portable supports that are left in place continuously for more than one work day. All flexible sign panels shall be mounted on supports with adequate bracing, so as to minimize flutter and to support the intended shape of the sign.

Intermixing reflective fluorescent orange colored signs with non-fluorescent orange colored flexible signs within the same series of signs shall not be allowed.

All construction signs shall be mounted in accordance with the MUTCD. Signs on rigid panels shall be mounted at a minimum height of 1.5 m. Flexible sign panels shall be mounted at a minimum height of 1.5 m, or optionally as low as 0.3 m when the following conditions are met:

1. On two lane, two-way roadways and four lane divided highways, when signs are placed on the left and the right sides of the roadway.
2. Where there will be no parked vehicles to obstruct the view.
3. When at least one advance work zone warning sign, mounted at a height of 1.5 m is located upstream of any flexible signs to alert motorists that they are entering a construction zone.
4. When the Engineer determines that the lower mounting height does not adversely affect the motorists' visibility of the sign.

If signs are temporarily covered, the cover shall be attached in a manner that completely covers the face of the sign. No adhesive shall be applied to the face of the sign, and the method of attaching the cover shall not damage the sign face. Sign covers shall be secured firmly to prevent dislodging and shall be maintained in good condition to present a neat appearance and minimize distraction to motorists traveling through the work zone. Sign covers shall contain no wording or images. Damaged covers which are determined by the Engineer to be no longer effective shall be replaced.

On limited access highways, when the normal legal speed limit is 80 km/h and higher, the contractor shall have available at the project site, sufficient warning signs as described below, to inform oncoming traffic of a stopped, or very slow traffic condition. These signs shall be placed, moved, covered, maintained and removed in a manner directed by the Engineer.

The sign shall measure 1.2 m x 1.2 m, and letters shall be 175 mm Series D, similar to a W8-10, except it shall read "BE PREPARED TO STOP." The background color shall be fluorescent orange (Materials Designation 730-05.04, Class D). Each sign shall be mounted on a suitable portable support, and each shall be equipped with a pair of warning flags conforming to the requirements of the MUTCD, Section 294.2. Both sides of the approach shall be signed unless the median is too narrow, or if there are fewer than three lanes in the approach.

The sign shall be posted approximately 457 m upstream of the end of the queue, and when the end of the queue moves, the sign shall also be moved to maintain that spacing. If the resulting location places the sign upstream of the first warning sign for the project, the contractor shall also furnish and place an appropriate general work zone sign. The work zone sign shall be placed approximately 304 m in advance of the "BE PREPARED TO STOP" sign.

Whenever a reduced regulatory speed limit for a highway work zone has been legally established by any means, the R-2 speed limit signs and, if used, the R2-10 speed zone

ahead signs for reduced speed shall be supplemented by a work zone warning panel as described below.

The panels shall be the same width as the speed limit sign they are supplementing. They shall be 150 mm high with 75 mm Series B lettering when used with size B speed limit signs; 200 mm high with 100 mm Series B lettering when used with size C speed limit signs; 300 mm high with 150 mm Series B lettering when used with size D speed limit signs and 400 mm high with 200 mm Series B lettering when used with size E speed limit signs. The panel shall read 'WORK ZONE' with black legend and fluorescent orange background (Materials Designation 730-05.04, Class D).

These panels shall be placed on the same posts and immediately above the speed limit signs.

METHOD OF MEASUREMENT. Payment shall be made at the lump sum price bid.

BASIS OF PAYMENT. The lump sum price bid shall include the cost of labor, equipment and material, necessary to erect, remove, relocate, protect, maintain, store or replace any construction signs required to properly sign the contract. The lump sum price bid shall also include the cost of repairing or replacing reflectorized signs, when the Engineer determines that the reflective sheeting material no longer meets the specifications.

No payment will be made under Section 619 Basic Maintenance and Protection of Traffic for each calendar day during which there are substantial deficiencies in compliance with the requirements of this specification, as determined by the Engineer. The amount of each calendar day non-payment will be determined by dividing the lump sum bid by the number of calendar days between the date the contractor commences work and the date of contract completion, as designated in the contract proposal, without regard to any extension of time.

In addition, liquidated damages will be assessed at the rate shown in Table 108-1 of Section 108-03, for each calendar day or part thereof that a cited deficiency, which results in non-payment, is not corrected, or is permitted to recur.

Partial payments will be made. Fifty (50) percent of the lump sum price will be paid when ten (10) percent of the contract work has been completed. The remaining fifty (50) percent will be paid proportionally in accordance with the total contract work completed, beginning with the estimate following the initial payment on this item.

Make the following changes to the Standard Specifications of January 2, 1990.

Page 7-197

Delete §730-05 Reflective Sheeting in its entirety and replace it with the following:

"730-05 REFLECTIVE SHEETING

SCOPE. These specifications cover reflective sheeting for use in the fabrication of highway and construction signs, delineators and other traffic control devices.

GENERAL. The reflective sheeting supplied shall be colored, flexible, weather resistant and shall have a smooth outer surface. If the reflective sheeting contains spherical lens elements, the lens elements shall be embedded within a transparent plastic, so as to produce a smooth, flat outer surface. All sheeting shall be of good appearance, free from ragged edges, cracks, scales, blisters, or other defects.

The back of the reflective sheeting shall be protected by a removable liner and shall include a precoated pressure sensitive or a heat activated adhesive, either of which may be applied without necessity of additional adhesive tack coats on the reflective sheeting or application surface.

Reflective sheeting shall be one of the following classes:

Class A (Materials Designation 730-05.01). A medium intensity reflective sheeting often referred to as engineer grade. It is recommended for highway signs, except where high reflectivity is required, and for construction barricades, panels and other work zone devices.

Class B (Materials Designation 730-05.02). A high intensity reflective sheeting often referred to as high intensity. It is recommended for highway signs, construction signs, delineators, and other work zone devices.

Class C (Materials Designation 730-05.03). A super-high intensity reflective sheeting recommended for delineators, construction barricades and vertical panels. This material is not recommended for highway or construction zone sign faces.

Class D (Materials Designation 730-05.04). A fluorescent orange colored sheeting with reflective properties similar to Class B high intensity. This sheeting is only recommended for use on orange colored construction signs, and for orange on construction barricades, vertical panels, and other work zone devices with rigid substrates, when a high level of conspicuity or visibility is needed.

MATERIAL REQUIREMENTS.

A. Reflective Sheeting Material. Reflective sheeting shall meet the following requirements.

1. **Class A.** Class A reflective sheeting shall conform to the requirements of AASHTO M 268, Type I.
2. **Class B.** Class B reflective sheeting shall conform to the requirements of AASHTO M 268, Type III.

English

3. **Class C.** Class C reflective sheeting shall conform to the requirements of AASHTO M 268, Type V.
4. **Class D.** Class D fluorescent orange reflective sheeting shall conform to the requirements of AASHTO M 268, with the following modifications.
 - a. **Coefficient of Retroreflection (R_A).** The coefficient of retroreflection shall meet or exceed the following minimum reflectivity requirements.

COEFFICIENT OF RETROREFLECTION, R_A
(cd/fc/sf)

Observation Angle (°)	Entrance Angle (°)	Minimum R_A
0.2	-4	100.0
0.2	+30	34.0
0.5	-4	64.0
0.5	+30	22.0

- b. **Daytime Color.** The color shall conform to the following requirements for luminance factor, maximum spectral radiance factor (peak reflectance), and color specification limits.

COLOR REQUIREMENTS

Luminance Factor (Y Percent)		Maximum Spectral Radiance Factor (%)	Color Specification Limits ⁽¹⁾							
			1	2	3	4				
Min.	Max.	Minimum	x	y	x	y	x	y	x	y
30.0	---	110.0	0.583	0.416	0.523	0.397	0.560	0.360	0.631	0.369

⁽¹⁾ Four pairs of chromaticity coordinates determine acceptable color in terms of the CIE, 1931 Standard Colorimetric System measured with Standard Illuminant D_{65} .

Color measurements shall be determined in accordance with ASTM E991, using instrumentation which has circumferential viewing (illumination). Calculations shall be performed in accordance with ASTM E308 for the CIE 1931 2° standard observer.

- c. **Artificial Weathering.** After 1500 hours of artificial weathering performed in

accordance with ASTM G 26, Method A, using a Type B weatherometer, the following requirements shall be met.

1. The minimum coefficient of retroreflection shall be 55.0 cd/fc/sf at 0.2 degree observation angle; -4 degree entrance angle.
2. The luminance factor (Y Percent) shall be from 20.0 to 45.0.
3. The maximum spectral radiance factor (peak reflectance) shall not be less than 60.0 percent.
4. The color specification limits shall conform to the requirements shown above in Item 4. Class D, b. Daytime Color.

B. Fabrication Details. The reflective sheeting shall be so fabricated as to allow easy cutting to specified sizes and shapes.

The sheeting surface shall be solvent resistant and shall permit solvent cleaning. All solvents used for cleaning operations shall be as recommended by the sheeting manufacturer and shall comply to all Federal, State and Local air quality regulations.

To assure uniform appearance and brilliance under both night and daytime conditions, the reflective sheeting shall be cut, matched and positioned on the prepared sign panel or other substrate in strict accordance with the recommendations of the sheeting manufacturer. Backgrounds, characters, delineators, etc., shall be coated and/or edge sealed in accordance with the recommendations of the sheeting manufacturer. When performed, coating operations shall be done in a workmanlike manner so as to create an even, clear, uniform coat which shall be free of streaks, drops or other defects which might affect reflectivity.

Reflective sheeting shall be furnished in both rolls and sheets. Rolls shall be packed individually and contain not more than four splices per 150 foot linear measurement. Cut sheets shall be packaged flat and in such a manner as to minimize any damage or defacement that may occur to the sheeting during shipment or storage. The sheeting surface shall be capable of being readily processed and be compatible with recommended transparent and opaque process inks. The finished sheeting surface shall show no loss of the color with normal handling, cutting and application.

C. Outdoor Exposure Testing. All reflective sheeting shall be exposed outdoors on a test deck for a minimum two year continuous time period. Outdoor testing shall consist of exposing reflective sheeting test specimen panels, facing south, and inclined at an angle of 45° from a horizontal position. The test deck facility shall be located in a climate similar to that in which the material is intended to be used, or at a site approved by the Materials Bureau. Testing shall be performed by an independent testing agency or in conjunction with the National Transportation Product Evaluation Program (NTPEP).

Following the two year outdoor exposure period, all weathered test panels of reflective sheeting shall meet the following performance requirements. The sheeting on the test panels shall show no appreciable adhesion loss, cracking, blistering, crazing, dimensional change, or color change. The minimum percent retained coefficient of retroreflection (R_A) shall be as specified below when

compared to a control unexposed specimen counterpart. The control specimen reflectivity values (R_A) shall be measured at the start of outdoor exposure testing. Measurements shall be taken at 0.2 degree observation angle; -4 degree entrance angle.

Minimum Percent Retained Coefficient of Retroreflection (R_A)	
Class A (Materials Designation 730-05.01)	50%
Class B (Materials Designation 730-05.02)	80%
Class C (Materials Designation 730-05.03)	80%
Class D (Materials Designation 730-05.04)	50%

BASIS OF ACCEPTANCE. All reflective sheeting shall be approved by the Materials Bureau. Detailed requirements and procedures for approval are available from the Materials Bureau.

Approvals of reflective sheeting will be based upon independent laboratory analysis and outdoor exposure testing conducted in accordance with this specification. If the reflective sheeting passes the requirements for laboratory and outdoor exposure testing, the product will then be placed on the Department's "Approved List" of materials.

Project acceptance will be based on the appearance of the sheeting material on the Department's approved list of reflective sheeting materials, and the manufacturer's certification of compliance to this specification."

Make the following changes to the Standard Specifications of January 2, 1995.

Page 7-265

Delete §730-05 Reflective Sheeting in its entirety and replace it with the following:

"730-05 REFLECTIVE SHEETING

SCOPE. These specifications cover reflective sheeting for use in the fabrication of highway and construction signs, delineators and other traffic control devices.

GENERAL. The reflective sheeting supplied shall be colored, flexible, weather resistant and shall have a smooth outer surface. If the reflective sheeting contains spherical lens elements, the lens elements shall be embedded within a transparent plastic, so as to produce a smooth, flat outer surface. All sheeting shall be of good appearance, free from ragged edges, cracks, scales, blisters, or other defects.

The back of the reflective sheeting shall be protected by a removable liner and shall include a precoated pressure sensitive or a heat activated adhesive, either of which may be applied without necessity of additional adhesive tack coats on the reflective sheeting or application surface.

Reflective sheeting shall be one of the following classes:

Class A (Materials Designation 730-05.01). A medium intensity reflective sheeting often referred to as engineer grade. It is recommended for highway signs, except where high reflectivity is required, and for construction barricades, panels and other work zone devices.

Class B (Materials Designation 730-05.02). A high intensity reflective sheeting often referred to as high intensity. It is recommended for highway signs, construction signs, delineators, and other work zone devices.

Class C (Materials Designation 730-05.03). A super-high intensity reflective sheeting recommended for delineators, construction barricades and vertical panels. This material is not recommended for highway or construction zone sign faces.

Class D (Materials Designation 730-05.04). A fluorescent orange colored sheeting with reflective properties similar to Class B high intensity. This sheeting is only recommended for use on orange colored construction signs, and for orange on construction barricades, vertical panels, and other work zone devices with rigid substrates, when a high level of conspicuity or visibility is needed.

MATERIAL REQUIREMENTS.

A. Reflective Sheeting Material. Reflective sheeting shall meet the following requirements.

- 1. Class A.** Class A reflective sheeting shall conform to the requirements of AASHTO M 268, Type I.
- 2. Class B.** Class B reflective sheeting shall conform to the requirements of AASHTO M 268, Type III.

Metric

3. **Class C.** Class C reflective sheeting shall conform to the requirements of AASHTO M 268, Type V.
4. **Class D.** Class D fluorescent orange reflective sheeting shall conform to the requirements of AASHTO M 268, with the following modifications.
 - a. **Coefficient of Retroreflection (R_A).** The coefficient of retroreflection shall meet or exceed the following minimum reflectivity requirements.

COEFFICIENT OF RETROREFLECTION, R_A
(cd/lx/m²)

Observation Angle (°)	Entrance Angle (°)	Minimum R_A
0.2	-4	100.0
0.2	+30	34.0
0.5	-4	64.0
0.5	+30	22.0

- b. **Daytime Color.** The color shall conform to the following requirements for luminance factor, maximum spectral radiance factor (peak reflectance), and color specification limits.

COLOR REQUIREMENTS

Luminance Factor (Y Percent)		Maximum Spectral Radiance Factor (%)	Color Specification Limits ⁽¹⁾							
			1	2	3	4				
Min.	Max.	Minimum	x	y	x	y	x	y	x	y
30.0	---	110.0	0.583	0.416	0.523	0.397	0.560	0.360	0.631	0.369

⁽¹⁾ Four pairs of chromaticity coordinates determine acceptable color in terms of the CIE, 1931 Standard Colorimetric System measured with Standard Illuminant D₆₅.

Color measurements shall be determined in accordance with ASTM E991, using instrumentation which has circumferential viewing (illumination). Calculations shall be performed in accordance with ASTM E308 for the CIE 1931 2° standard observer.

- c. **Artificial Weathering.** After 1500 hours of artificial weathering performed in

Metric